# 3.7 NOISE

## 3.7.1 Noise Terminology and Descriptors

The decibel (dB) scale used to describe sound is a logarithmic scale that provides a convenient system for considering the large differences in audible sound intensities. On this scale, a 10-dB increase represents a perceived doubling of loudness to someone with normal hearing. Therefore, a 70-dB sound level will sound twice as loud as a 60-dB sound level. A doubling of sound energy results in a 3-dB increase. Under ideal listening conditions, people generally cannot detect differences of 1 dB, while differences of 2 or 3 dB can usually be detected by people with normal hearing. In the outside environment, and especially near complex noise sources such as roads, sound level changes of 2 or 3 dB might not be noticeable to most people, while a 5-dB change would likely be perceived as a clear and noticeable change.

Because of the logarithmic scale used to describe noise, a doubling of a noise source strength (e.g., twice as much traffic on a road) produces a 3-dB increase in average roadway noise. Such an increase would not be perceived as a doubling in noise loudness, which requires a 10-dB increase. Sound levels caused by line sources (e.g., relatively long, variable, or moving sound sources such as traffic) decrease at a rate of 3 dB when the distance from the road is doubled due to distance attenuation. Sounds from discrete events or stationary point sources, such as an idling bus, decrease by 6 dB when the distance from the source is doubled. Conversely, halving the distance to a source increases sound levels by 3 dB and 6 dB for roadway and point sources, respectively.

When addressing the effects of noise on people, one must consider the "frequency response" of the human ear, or those sounds that people hear best. To address the frequency response, instruments that measure sounds are designed to "weight" measured sound levels based on emphasizing the frequencies people hear best, and de-emphasizing those frequencies people do not hear as well. The frequency-weighting most often used to evaluate environmental noise is A-weighting, and measurements from instruments using this system are reported in "A-weighted decibels" or dBA. All sound levels in this evaluation are reported in A-weighted decibels.

For a given noise source, factors affecting the sound transmission from the source and the potential related noise impact include distance from the source, frequency of the sound, absorbency of the ground surface, the presence or absence of obstructions and their absorbency or reflectivity, and the duration of the sound. The degree of impact on humans may also depend on existing sound levels, and also may depend on who is listening. For example, if existing sound levels are high, introducing a new noise source tends to have less impact than in an environment where background noise levels are low. Typical sound levels of some familiar noise sources and activities are presented in **Table 3.7-1**.

Table 3.7-1

SOUND LEVELS PRODUCED BY COMMON NOISE SOURCES

| Thresholds/ Noise Sources | Sound Level (dBA) | Subjective Evaluations [a] | Possible Effects on Humans [a] |
|---|---|---|---|
| Human Threshold of Pain | 140 | Deafening | Continuous exposure to levels above 70 can cause hearing loss in majority of population |
| Siren at 100 ft<br>Loud rock band | 130 | | |
| Jet takeoff at 200 ft<br>Auto horn at 3 ft | 120 | | |
| Chain saw<br>Noisy snowmobile | 110 | | |
| Lawn mower at 3 ft<br>Noisy motorcycle at 50 ft | 100 | Very Loud | |
| Heavy truck, maximum at 50 ft | 90 | | |
| Pneumatic drill at 50 ft<br>Busy urban street, daytime | 80 | Loud | |
| Normal automobile at 50 mph<br>Vacuum cleaner at 3 ft | 70 | | Speech Interference |
| Air conditioning unit at 20 ft<br>Conversation at 3 ft | 60 | Moderate | |
| Quiet residential area<br>Light auto traffic at 100 ft | 50 | | Sleep Interference |
| Library<br>Quiet home | 40 | Faint | |
| Soft whisper at 15 ft | 30 | | |
| Slight rustling of leaves | 20 | Very Faint | |
| Broadcasting Studio | 10 | | |
| Threshold of Human Hearing | 0 | | |

[a] Note that both the subjective evaluations and the physiological responses are continuums without true threshold boundaries. Consequently, there are overlaps among categories of response that depend on the sensitivity of the noise receivers.

Source: EPA 1974 and Others

Many regulatory agencies use the equivalent sound level ($L_{eq}$) to evaluate noise impacts and potential community response to noise. The equivalent sound level is the level of a constant sound that has the same sound energy as the actual fluctuating sound. As such, the $L_{eq}$ can be considered an energy-average sound level. When referring to sound levels, it is important to identify the time period being considered, with $L_{eq(24)}$, for example, being the equivalent sound level for a 24-hour period. The day-night sound level ($L_{dn}$) is similar to an $L_{eq(24)}$, except that the calculation involves adding 10 dBA to sound levels measured between 10 p.m. and 7 a.m. to account for potential sleep interference.

## 3.7.2 Regulatory Overview

The Greenbridge Development Project is located within unincorporated King County, and the project would use both local and federal funding. Therefore, both federal and local noise regulations would apply to different elements of the project. Applicable noise regulations are described below.

### King County Noise Limits

Noise from construction would be governed by the timing restrictions and the noise limits included in the King County noise code requirements (KCC, Chapter 12.88). This rule defines maximum permissible sound levels based on the zoning of the source and receiving properties. With these limits as a base, the rule also sets maximum levels and durations of allowable daytime construction noise. A summary of the King County noise code requirement limits for operational and construction noise is displayed in **Table 3.7-2**.

SW Roxbury Street runs along the northern border of the project site, which divides the City of Seattle to the north and unincorporated King County to the south. This section references the King County Code only, but it should be noted that potential impacts north of SW Roxbury Street as a direct result of the project are subject to the noise limits established by the City of Seattle. The City of Seattle has established noise rules which are, for the purposes of this analysis, identical to the King County code requirements governing noise limits at residential receivers. Therefore, any discussion of off-site impacts referencing the King County code would apply equally to those off-site receivers located north of SW Roxbury Street, within the City of Seattle.

Noise from motor vehicles traveling on public roadways is exempt from the King County noise limits (KCC 12.90.060). These levels can nonetheless be used as a reference point for determining the relative impacts of measured and predicted sound levels from traffic. But there is no legally applicable definition of a traffic noise impact.

Table 3.7-2

KING COUNTY MAXIMUM PERMISSIBLE LEVELS AND CONSTRUCTION NOISE LIMITS (DBA)

| Zoning District of Noise Source [12.88.020A & 12.88.030] | Zoning District of Receiving Property | | | |
|---|---|---|---|---|
| | Rural | Residential Day / Night | Commercial | Industrial |
| Rural | 49 / 39 | 52 / 42 | 55 | 57 |
| Residential | 52 / 42 | 55 / 45 | 57 | 60 |
| Commercial | 55 / 45 | 57 / 47 | 60 | 65 |
| Industrial | 57 / 47 | 60 / 50 | 65 | 70 |
| **Daytime Construction Noise Limits** – at 50' or a real property line, whichever is greater. *Construction noise is limited to the higher levels listed below, **during daytime hours only**, which are defined as 7 A.M. to 10 P.M. weekdays and 9 A.M. to 10 P.M. weekends. These limits effectively prohibit construction at night except in special cases.* | | | | |
| ***On-site sources*** like dozers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, and pneumatic equip (**maximum+25**) [12.88.040 1] | | | | |
| Residential | 77 | 80 | 82 | 85 |
| Commercial | 80 | 82 | 85 | 90 |
| Industrial | 82 | 85 | 90 | 95 |
| ***Portable*** equip used in temporary locations in support of construction like chain saws, log chippers, and powered hand tools (**maximum+20**) [12.88.040 2] | | | | |
| Residential | 72 | 75 | 77 | 80 |
| Commercial | 75 | 77 | 80 | 85 |
| Industrial | 77 | 80 | 85 | 90 |
| ***Maintenance or repair*** equip used for grounds-keeping like lawnmowers, powered hand tools, and snow-removal equip (**maximum+15**) [12.88.040 3] | | | | |
| Residential | 67 | 70 | 72 | 75 |
| Commercial | 70 | 72 | 75 | 80 |
| Industrial | 72 | 75 | 80 | 85 |
| ***Impact types of equipment*** like pavement breakers, pile drivers, jackhammers, sand-blasting tools, or other impulse noise sources – may exceed maximum permissible limits between 8 a.m. and 5 p.m. weekdays and 9 a.m. and 5 p.m. weekends, but may not exceed the following limits [12.88.040 B]: Leq(1 hr) 90 dBA; Leq(30 minutes) 93 dBA; Leq(15 minutes) 96 dBA; Leq(7.5 minutes) 99 dBA | | | | |

### *Department of Housing and Urban Development Noise Limits*

The Department of Housing and Urban Development (HUD) is bound by several federal noise control statutes and is required to "be aware of the problem of noise and to take positive steps to protect residential and other sensitive land uses from high noise levels."[1] As explained in a HUD publication (1985):

> The HUD first issued formal requirements related specifically to noise in 1971 (HUD Circular 1390.2). The requirements contained standards for exterior noise levels along with policies approving HUD supported or assisted housing projects in high noise areas. In general the requirements established three zones; an acceptable zone where all projects could be approved, a normally unacceptable zone where mitigation measures would be required and where each project would have to be individually evaluated for approval or denial, and an unacceptable zone in which projects would not, as a rule, be approved. In 1979, the Department issued revised regulations (24 CFR Part 51B) which kept the same basic standards but adopted new [noise] descriptor systems which were considerably advanced over those in use under the old requirements.

HUD recommends that outdoor day-night sound levels not exceed 65 dBA in residential areas (**Table 3.7-3**). Federal funding for housing projects in areas which exceed an $L_{dn}$ of 65 dBA is normally withheld unless there is special approval, based on particular circumstances and specific criteria.

Table 3.7-3
HOUSING AND URBAN DEVELOPMENT NOISE GUIDELINES

| HUD Noise Standards | Day-Night Average Sound Level | HUD Noise Standards |
|---|---|---|
| Acceptable | Above 55 [a] but Not Exceeding 65 | None |
| Normally Unacceptable | Above 65 but Not Exceeding 75 | Special Approvals, Environmental Review, and Attenuation [b] |
| Unacceptable | Above 75 | Special Approvals, Environmental Review, and Attenuation [c] |

[a] HUD, DOT and EPA recognize Ldn = 55 dB as a goal for outdoors in residential areas in protecting the public health and welfare with an adequate margin of safety. However, it is not a regulatory goal. It is a level defined by a negotiated scientific consensus without concern for economics and technological feasibility or the needs and desires of any particular community.

[b] 5 dBA additional attenuation required for sites above 65 dB but not exceeding 70 dB, and 10 dB additional attenuation required for sites above 70 dB but not exceeding 75 dB

[c] Attenuation measures to be submitted to the Assistant Secretary for CPD on a case-by-case basis.

Source: The HUD Guidebook 1985

[1] U.S. HUD, 1985. p.4

The HUD noise policy is further clarified in the following excerpts from the same HUD publication:

> (8) **Exterior noise goals**. It is a HUD goal that exterior noise levels do not exceed a day-night average sound level of 55 decibels. This level is recommended by the Environmental Protection Agency as a goal for outdoors in residential areas. The levels recommended by EPA are not standards and do not take into account cost or feasibility. For the purposes of this regulation, and to meet other program objectives, ***sites with a day-night average sound level of 65 and below are acceptable and allowable.***
>
> (9) **Interior noise goals**. It is a HUD goal that the interior auditory environment shall not exceed a day-night average sound level of 45 decibels. Attenuation measures shall be employed where feasible. Emphasis shall be given to noise sensitive interior spaces such as bedrooms.[2]

As noted above, HUD's environmental criteria describe noise attenuation techniques that are applicable to proposals located within "normally unacceptable" noise zones (24 CFR 51.103-51.104). HUD's rules also contains an exception to the 65 dB objective which is intended to permit consideration of other program objectives unrelated to noise, and to provide flexibility (24 CFR 51.105). These exceptions apply where the project is located in an urban area and would not encourage incompatible development (and an EIS is not required for this reason); where quieter sites meeting program goals are generally not available; and where the proposal meets other HUD program (i.e., HOPE VI) goals, conforms to local goals and maintains the character of the neighborhood. The project proponent must demonstrate that noise attenuation techniques cannot meet the 65 dB objective and the analysis and mitigation discussed in Section 4.7 requires final approval by the NEPA Responsible Entity.

## Federal Highway Administration & Washington State DOT

The Federal Highway Administration (FHWA) has adopted noise standards that apply to traffic noise associated with its projects. These standards do not apply to Greenbridge because they are intended for use along roads controlled by state or federal agencies that are being structurally altered by a project or action. However, the FHWA traffic noise limits, and the Washington state implementation of these rules through state policies, are discussed below to provide readers a perspective on the noise levels discussed.

The FHWA identified noise criteria and established procedures for evaluating road improvement projects in its Federal-Aid Highway Manual (U.S. Department of Transportation, 1982b). These criteria and procedures are now codified in 23 CFR 772. The FHWA defines a traffic noise impact as a predicted traffic noise level approaching or exceeding the noise abatement criteria in **Table 3.7-4**, or when the predicted traffic noise levels substantially exceed the existing noise levels. FHWA leaves the definition of "approach" to the states. The Washington State Department of Transportation (WSDOT) defines "approaching" the FHWA limits as sound levels within 1 dBA of the criterion level. WSDOT defines "substantially exceeding" existing noise levels as an increase of 10 dBA or more if the calculated future sound level is greater than 50 dBA.

[2] Federal Register/Vol.44, No. 235/ Thursday 7/12/79. Part 51 - Environmental Criteria and Standards. Subpart B - Noise Abatement and Control. ' 51.100 (8) and (9)

Table 3.7-4

FHWA ROADWAY NOISE ABATEMENT CRITERIA (DBA)

| LAND USE CATEGORY | HOURLY $L_{eq}$ (dBA) |
|---|---|
| (A) Land on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. | 57 (exterior) |
| (B) Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals. | 67 (exterior) |
| (C) Developed lands, properties, or activities not included in the above categories. | 72 (exterior) |
| (D) Undeveloped lands | ------ |
| (E) Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums. | 52 (interior) |
| Source: Federal noise rules in 23 CFR 772 | |

## 3.7.3 Affected Environment

The existing noise environment on-site consists of a relatively quiet residential neighborhood, surrounded by single family residential areas to the north, west, and south. The main source of noise is traffic from nearby roadways (SW Roxbury Street is the most heavily traveled local roadway) and frequent overhead aircraft. There is currently construction activity at an on-site school, which is expected to be complete before the Greenbridge project begins. The noise environment at neighboring residential areas is likely similar to the existing development. In general, sound levels are highest close to SW Roxbury Street, and relatively quiet at locations further from this roadway.

### Measured Existing Sound Levels

To characterize the existing acoustic environment, one day-long sound level measurement was taken in a representative location on the project site in an area with sensitive receivers where worst-case traffic noise levels would be expected. This measurement was also used to document off-site traffic noise at nearby off-site receivers within the vicinity of this measurement. Short-term sound levels were taken on site in an area representative of the majority of on-site receivers, where no major source of noise exists. Lastly, a short-term sound level measurement was taken at an off-site location to document the existing sound levels in an area potentially affected by an increase in project-related traffic. Results of the sound level measurements are shown in Table 3.7-5.

Table 3.7-5

MEASURED EXISTING SOUND LEVELS

| SLM Number | Time | Hourly $L_{eq}$ (dBA) | 24-Hour $L_{dn}$ (dBA) |
|---|---|---|---|
| Long Term Measurements | | | |
| SLM 1 | Day | 65 – 68 | 71 |
| | Night | 57 – 70 | |
| Short-Term Sound Levels | | | |
| SLM 2 | 15 min, 17:35 | 56 | |
| SLM 3 | 15 min, 11:29 | 51 | |
| SLM 4 | 15 min, 12:13 | 57 | |

**SLM 1** was taken in the backyard of 822 SW 96th Place, adjacent to SW Roxbury Street. The meter was 17 feet south of the chain link fence (property line), and slightly above the grade of SW Roxbury Street. This measurement is representative of residential units within the existing development that are adjacent to SW Roxbury Street (first row receivers), all of which are located approximately the same distance south of the roadway. Major sources of noise observed during set-up and retrieval of the meter were traffic along SW Roxbury Street. Other sources of noise included children playing nearby, miscellaneous neighborhood noises, and overhead aircraft. The meter was not staffed during the nearly two days it was deployed, and so not all sources of noise, especially during the nighttime hours, can be identified. Because SW Roxbury Street is considered a principal arterial, it can be assumed that traffic along this roadway accounted for most of the major noise sources during all hours.

**SLM 2** was taken just south of SW 97th Street, between 9th Place SW and 9th Avenue SW, facing SW 97th Street (looking north). The measurement was taken simultaneously with a brief portion of SLM 1 in order to document the sound levels on-site to compare with the results of sound levels closer to a major roadway (a major noise source). This measurement is representative of sound levels at adjacent residences, and residences located throughout the existing development. The major source of noise noted during the measurement was overhead aircraft. Minor sources of noise included smaller planes, children playing, local traffic (only 6 cars total noted along SW 97th Street during the 15 minute measurement), birds, miscellaneous neighborhood noise, and traffic on SW Roxbury Street.

**SLM 3** was taken in the same location as SLM 2, but two days later and at an earlier time of the day. This measurement was taken to confirm results of SLM 2, and to further document on-site noise sources away from SW Roxbury Street. During this measurement, aircraft traffic was frequent, and was the only major source of noise. Minor sources of noise were similar to SLM 2, with the addition of a loud car stereo passing by, and some nearby music.

**SLM 4** was taken along SW 100th Street to measure traffic noise at off-site receivers. The meter was placed on the southwest corner of the lawn at 1003 SW 100th Street, on the north side of the road. Although this location is actually on-site, it is representative of nearby off-site homes located on both the north and south sides of SW 100th Street. The major source of noise was traffic along SW 100th Street. Minor sources of noise included cars on nearby roads, some miscellaneous neighborhood noise, the constant hum of industrial equipment distant to the southwest, and overheard aircraft.

Source: MFG, Inc. 2003